Unravelling the Mystery of Memory through Near-Death Experiences

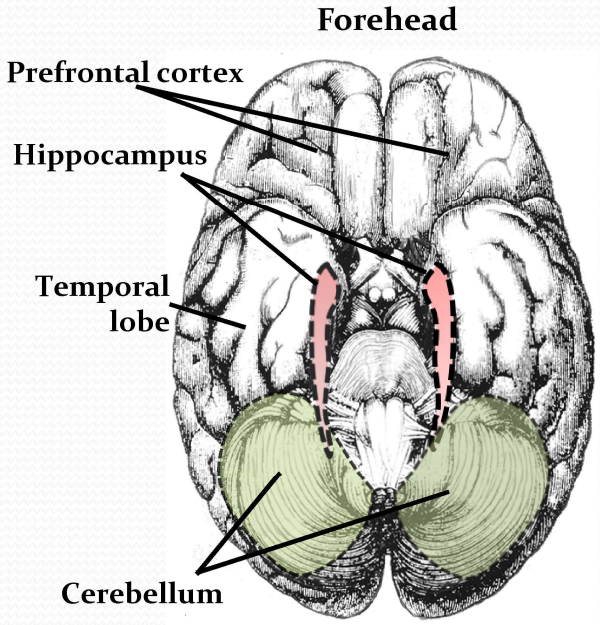
Robert G. Mays, BSc
Suzanne B. Mays, AA, CMP
www.selfconsciousmind.com

2016 IANDS Conference, Orlando, Florida
July 28, 2016

The Mystery of Memory

Three main types of memory

- **Episodic memory (experienced events)**
  - **Location: hippocampus**
- **Semantic knowledge (facts, word meanings, etc.)**
  - **Location: global??**
- **Pattern memory (movement & speech patterns, habits, instincts in animals)**
  - **Location: cerebellum**
- **Working memory (up to 30 sec)**
  - **Location: prefrontal cortex**

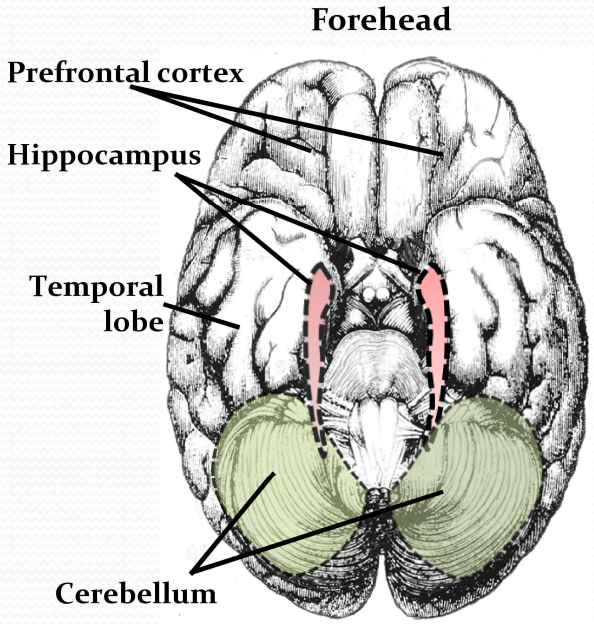


Brain – bottom view

The Mystery of Memory

Three main types of memory

- **Episodic memory (experienced events)**
  - **Location: hippocampus**
- **Semantic knowledge (facts, word meanings, etc.)**
  - **Location: global??**
- **Pattern memory (movement & speech patterns, habits, instincts in animals)**
  - **Location: cerebellum**
- **Working memory (up to 30 sec)**
  - **Location: prefrontal cortex**
- **Where and how is memory formed and stored?**
  - **Conventional view: long-term potentiation**
- **How is memory recalled?**



Brain – bottom view

Patient H.M. (Henry Molaison)

- Surgical removal of both hippocampi
- Complete inability to form / recall episodic memories
- Retained prior semantic knowledge, working memory, pattern memory
- But could not form new semantic knowledge easily
  - Semantic knowledge ordinarily comes from consolidating episodic events
  - H.M. formed some semantic knowledge directly through repetition of emotional content
    - Examples: JFK assassination, Skylab, Archie Bunker

Henry Molaison (1926-2008)

The Mystery of Near-Death Experiences

Striking elements of NDEs

- **Feel separated from the physical body**
- **Aware of things going on elsewhere**
- **Scenes from one's past come to one (life review)**
- **Enter some other, unearthly world**
- **See deceased or religious spirits**
- **Encounter a mystical presence or a brilliant light**

The Mystery of Near-Death Experiences

Striking elements of NDEs

- Feel separated from the physical body
- Aware of things going on elsewhere
- Scenes from one's past come to one (life review)
- Enter some other, unearthly world
- See deceased or religious spirits
- Encounter a mystical presence or a brilliant light

Striking phenomenological aspects of NDEs

- Apparently nonphysical veridical perceptions (AVPs)
  - Accurate, verified perceptions of physical environment
  - Frequently when brain function is compromised (coma, cardiac arrest)
- Hyperreal perceptions
- Indelible memories of the experience, "relived" when recalled
- Numerous aftereffects: "the most significant event of my life"

What's going on in NDEs?

Two opposing explanatory hypotheses

- "<u>Brain production</u>" - Brain activity produces these effects
  - Imagined or constructed, either before or after the period of unconsciousness
  - Hallucinations: hypoxia, endorphins, neurotransmitters
- "<u>Mind-entity</u>" - Consciousness or mind separates from the body

Special Nature of Memories of NDEs

- **Marie Thonnard, Steven Laureys and colleagues (2013) from University of Liège in Belgium**

- **Compared the memories of NDErs with others who were in coma without an NDE**
  - **Compared NDE memories with memories of real and imagined events**
  - **Used a Memory Characteristics Questionnaire (MCQ)**
  - **Significantly more characteristics: visual details, memory clarity, memories of being involved in the event & emotional content**

Marie Thonnard

Steven Laureys

- Thonnard, M., Charland-Verville ,V., Brédart, S., Dehon, H., Ledoux, D., Laureys, S., & Vanhaudenhuyse, A. (2013) Characteristics of near-death experiences memories as compared to real and imagined events memories. *PLoS ONE 8*(3): e57620.

Special Nature of Memories of NDEs

- **Marie Thonnard, Steven Laureys and colleagues (2013) from University of Liège in Belgium**

- **Compared the memories of NDErs with others who were in coma without an NDE**
  - **Compared NDE memories with memories of real and imagined events**
  - **Used a Memory Characteristics Questionnaire (MCQ)**
  - **Significantly more characteristics: visual details, memory clarity, memories of being involved in the event & emotional content**

- **Concluded: NDEs can't be considered as imagined events; NDE events are really perceived**
  - **Contradicts skeptics' assertions: NDEs are dream-like memories or are altered memories of real events**
  - **NDEr remembers being actively involved in the event**
  - **"What makes the NDEs 'unique' is the perception of the experience itself"**

Marie Thonnard

Steven Laureys

- Thonnard, M., Charland-Verville ,V., Brédart, S., Dehon, H., Ledoux, D., Laureys, S., & Vanhaudenhuyse, A. (2013) Characteristics of near-death experiences memories as compared to real and imagined events memories. *PLoS ONE 8*(3): e57620.

NDEr Memories: Replication & Enhancement

- **Arianna Palmieri, Paola Sessa and colleagues (2014) from University of Padova in Italy**

- **Repeated the Thonnard et al. study of NDEr memories using MCQ**
  - **Found the same results: NDE memories had greater detail, richness and complexity compared to imagined events**
  - **No significant difference between NDEs and real memories (same amount of detail)**

Arianna Palmieri

Paola Sessa

- Palmieri, A., Calvo, V., Kleinbub, J. R., Meconi, F., Marangoni, M., Barilaro, P., ... & Sessa, P. (2014). "Reality" of near-death-experience memories: evidence from a psychodynamic and electrophysiological integrated study. *Frontiers in human neuroscience, 8*.(429), 1–16.

NDEr Memories: Replication & Enhancement

- **Arianna Palmieri, Paola Sessa and colleagues (2014) from University of Padova in Italy**

- **Repeated the Thonnard et al. study of NDEr memories using MCQ**
  - **Found the same results: NDE memories had greater detail, richness and complexity compared to imagined events**
  - **No significant difference between NDEs and real memories (same amount of detail)**

- **Added two enhancements:**
  - **Used hypnosis-based clinical protocol to improve recall and decrease memory inaccuracy, for all subjects**
  - **Used EEG recording to investigate the neural signature of NDE memories versus real and imagined memories**
  - **The MCQ score was evaluated *before* and *after* the hypnosis/EEG session, giving a measure of the improvement in memory recall—ΔMCQ**

Arianna Palmieri

Paola Sessa

- Palmieri, A., Calvo, V., Kleinbub, J. R., Meconi, F., Marangoni, M., Barilaro, P., ... & Sessa, P. (2014). "Reality" of near-death-experience memories: evidence from a psychodynamic and electrophysiological integrated study. *Frontiers in human neuroscience, 8*.(429), 1–16.

NDE versus Real Memories: Results

Effect of hypnosis in this study

- **A significant increase in MCQ score for memories in all experimental conditions**
- **Increase in MCQ score was significantly *higher* for NDE and real memory recall than for imagined memory recall**
- **Further confirmation that NDEs are not imagined events**

EEG results: suggest a qualitative difference in the way NDE vs. real memories are recalled

- **NDE memory recall: low-frequency frontal and temporal involvement**
- **Real memory recall: high-frequency central and temporal involvement**

- Palmieri, A., Calvo, V., Kleinbub, J. R., Meconi, F., Marangoni, M., Barilaro, P., ... & Sessa, P. (2014). "Reality" of near-death-experience memories: evidence from a psychodynamic and electrophysiological integrated study. *Frontiers in human neuroscience, 8*.(429), 1–16.

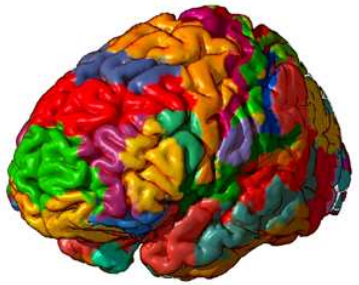
Mind-entity Hypothesis

- **The mind can separate from the brain and body as an energetic nonmaterial entity**
- **In ordinary consciousness, the mind interacts directly with physical processes in the brain**
  - **Evidence comes from NDEs: interactions with physical processes – light, sound, solid objects**
  - **And other NDE phenomena**

- Mays, R. G., & Mays, S. B. (2008). The phenomenology of the self-conscious mind. *Journal of Near-Death Studies, 27*(1), 5–45.
- Mays, R. G., & Mays, S. B. (2011). A theory of mind and brain that solves the 'hard problem' of consciousness. Presented at the annual conference of the International Association for Near-Death Studies (IANDS), Durham, NC.
- Mays, R. G., & Mays, S. B. (2015). Explaining Near-Death Experiences: Physical or Non-physical Causation? *Journal of Near-Death Studies, 33*(3), 125-149.

Interface between mind and brain

- **The brain is a sophisticated *mechanism* used by the mind**
- **Mind and brain have a closely coupled *interface***
  - **The mind is *embodied* in the brain and physical body; the brain is an *extension* of the mind**
- **Ordinary conscious awareness occurs *only* through brain activity**
- **Neural cortical regions have specific functions**
- **The mind interfaces differently in the different regions of the brain**
  - **Visual areas vs. motor areas vs. executive areas**
- **<u>All memory content is located in the mind</u>**

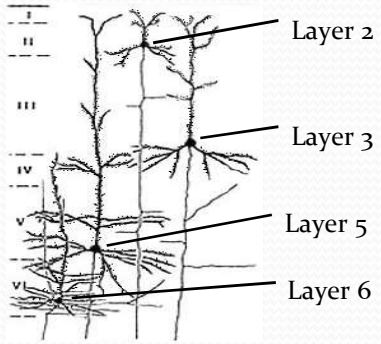


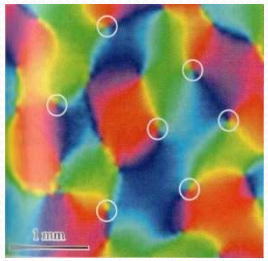
Functional areas of the cortex

Brey, P. (2000). Technology and embodiment in Ihde and Merleau-Ponty. In C. Mitcham, *Metaphysics, Epistemology, and Technology. Research in Philosophy and Technology*, vol. 19. London: Elsevier.

How the mind works with the brain

- **Interface between mind and brain is at cortical surface**
  - **Proposed mind-brain interface is with apical dendrites at the surface of the cortex (layer 2-3 and 5 pyramidal neurons)**
  - **Interfaces through functional columns (~0.5 mm)**





Functional columns (~0.5 mm each)

- **It takes time for electrical neural activity to build up to conscious awareness**
  - **Discovered by Benjamin Libet through a number of experiments ("time-on" principle)**
  - **The mind is engaged *throughout* the process of "coming to awareness"– awareness remains *subliminal* until fully conscious**

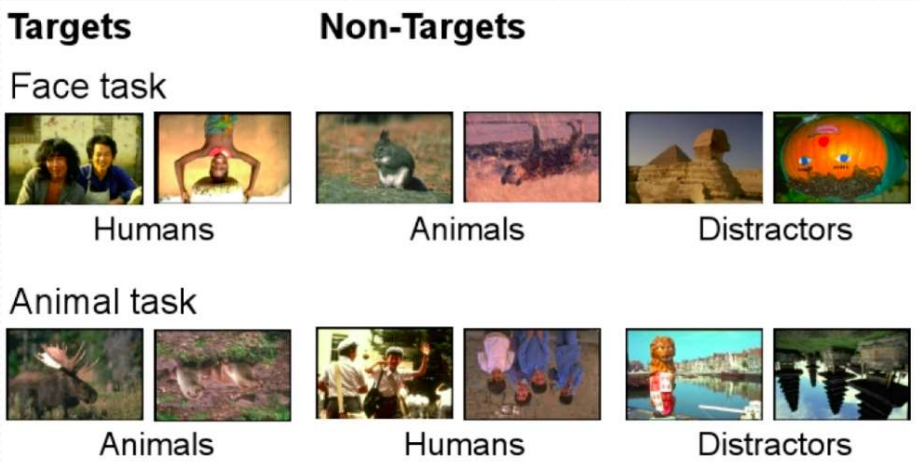
Benjamin Libet (1916-2007)

Libet, B. (2004). *Mind time: the temporal factor in consciousness*. Cambridge, MA: Harvard University Press.

Speed of Sight – Simon Thorpe

Ultra-rapid visual categorization

- **Natural scene with or without an animal, flashed for 20 msec**
- **Subjects can correctly (94%) say the photo contains an animal or not**
- **Very robust phenomenon: animals, faces, cars, etc.; upright or inverted; color or black and white**
- **Limited to coarse visual representation, not details (can identify it's an animal but can't say if it's a dog)**
- **Subjects report they perceive "a fully segmented scene in which the relations of all the objects in the image are clear"**



- Thorpe, S., Fize, D., & Marlot, C. (1996). Speed of processing in the human visual system. *nature*, *381*(6582), 520-522.
- Fabre-Thorpe, M., Delorme, A., Marlot, C., & Thorpe, S. J. (2001). A limit to the speed of processing in ultra-rapid visual categorization of novel natural scenes. *Journal of Cognitive Neuroscience*, *13*(2), 171-180.
- Rousselet, G. A., Macé, M. J. M., & Fabre-Thorpe, M. (2003). Is it an animal? Is it a human face? Fast processing in upright and inverted natural scenes. *Journal of vision*, *3*(6), 5-5.

Speed of Sight – Example

- Caveats
  - Picture selection
  - Precision of timing
- Procedure
  - Blank screen: 5 sec (or 1 sec)
  - Plus sign (focus): 1 sec
  - Visual scene (nominally 20 msec)
  - Blank screen 5 sec – write down as quickly as possible:
    - Animal or no-animal??
  - Repeat for next test

Speed of Sight – Example

Speed of Sight – Answers

1. Animal

2. Animal

3. No

4. No

5. Animal

6. No

7. No

8. Animal

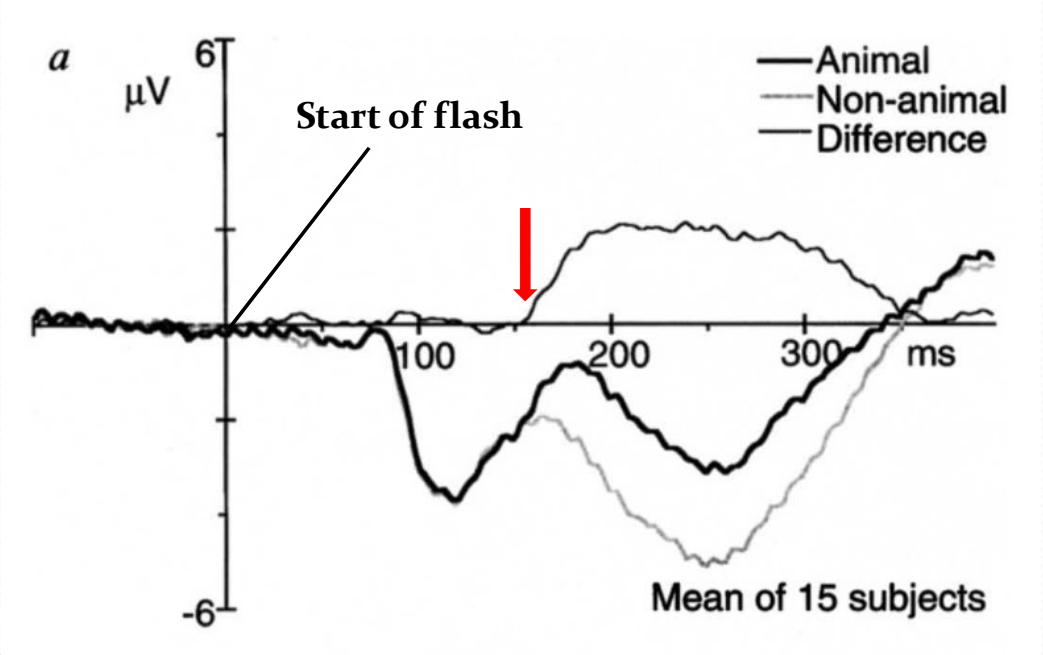
9. Animal

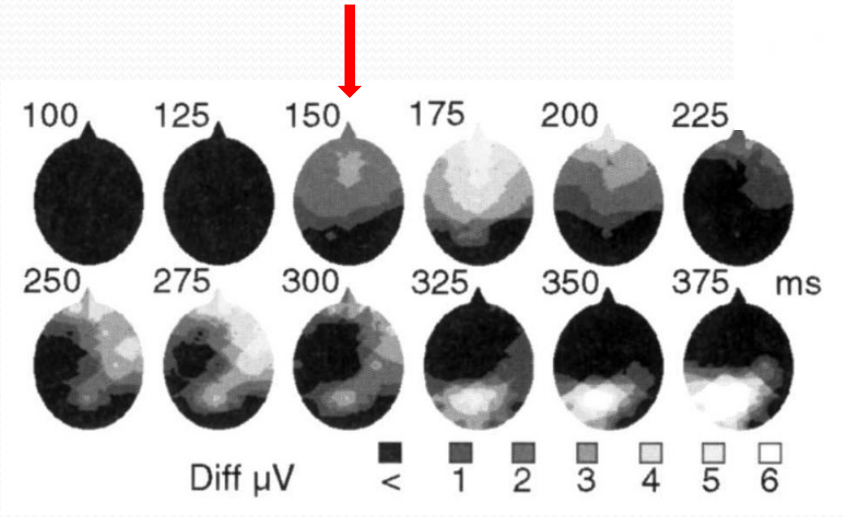
10. No

Speed of Sight – EEG Data

Animal/no-animal distinction begins to arise in EEG after 150 msec

EEG shown is average of 15 subjects over the prefrontal cortex





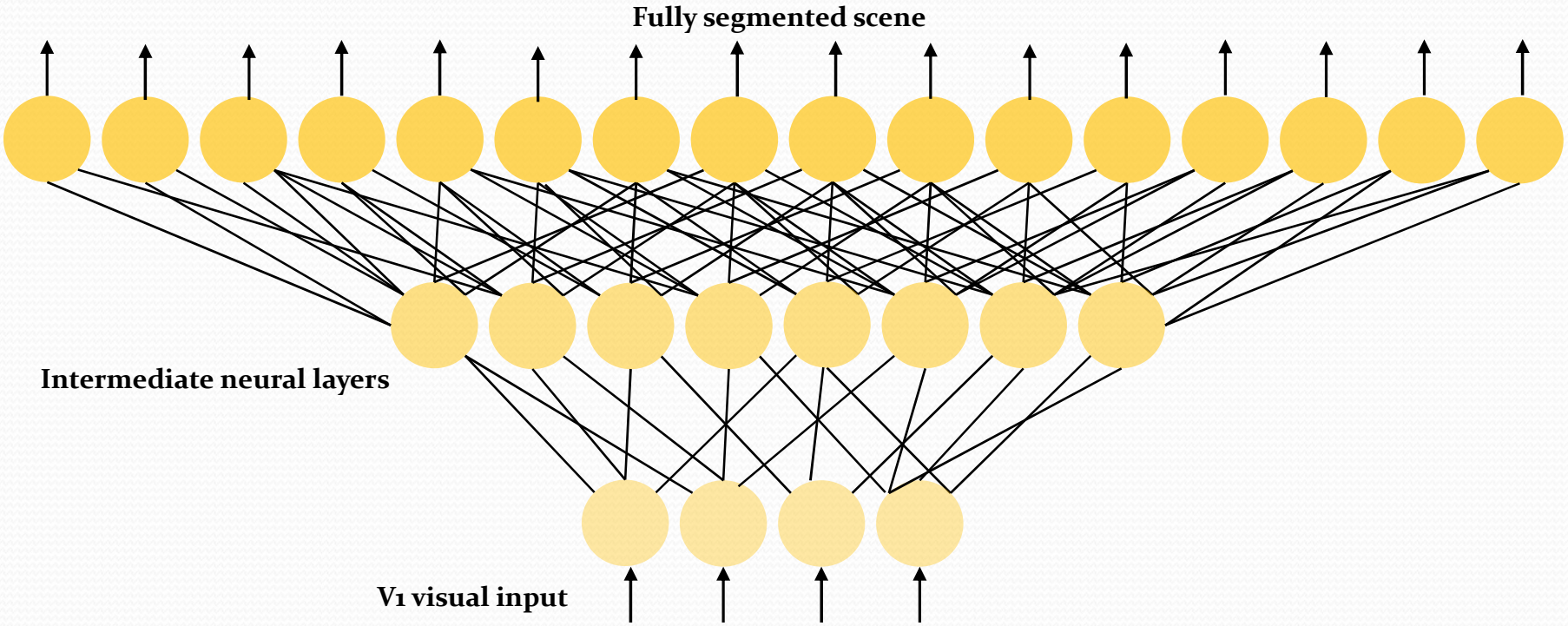
Starting in the medial prefrontal cortex

NOTE: this is a plot of the animal/no-animal difference in the spectral power as it spreads across the cortex over time, for one of the 15 subjects

- Thorpe, S., Fize, D., & Marlot, C. (1996). Speed of processing in the human visual system. *nature*, *381*(6582), 520-522.

Speed of Sight – Implications

- Thorpe et al. believe the results imply a type of "feed forward" mechanism from the visual cortex to other parts of the brain
  - Initial visual representation is propagated forward through a sophisticated neural network
  - The representation arrives as a fully segmented image in the prefrontal cortex which the subject recognizes consciously

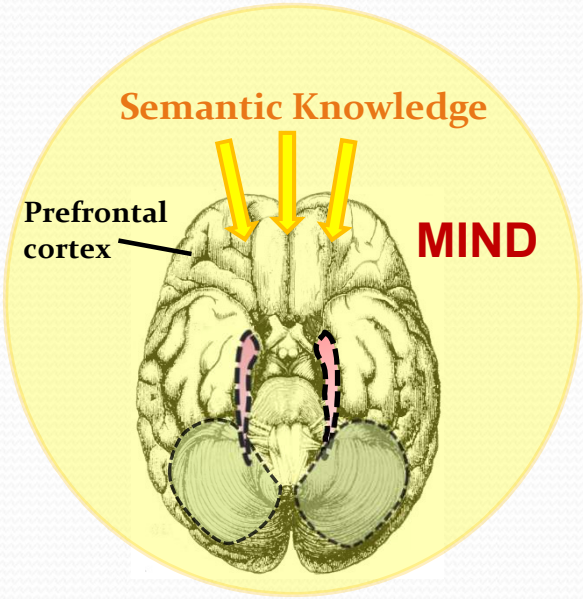


Speed of Sight – Implications …

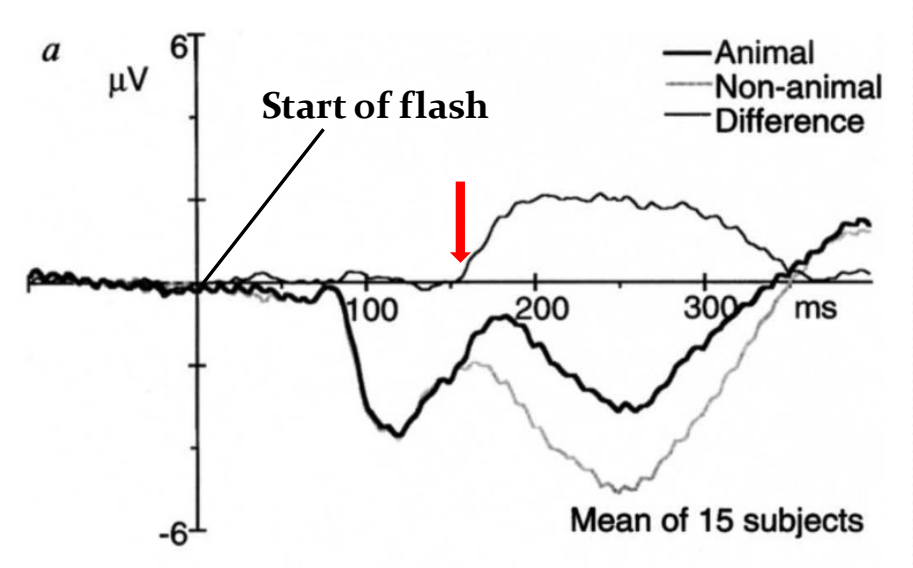
In our view …

- **Thorpe et al. results suggest that the segmented perceptual scene is *immediately* available to the mind as *semantic knowledge***
  - **The semantic knowledge becomes reflected in the prefrontal cortical electrical activity**
  - **The electrical activity proceeds to other cortical areas and the visual percept comes to consciousness over the next 200 msec (Libet's time-on principle)**
  - **The visual percept arrives as a unity of semantic knowledge—there is no "binding *problem*"—the unity was already there—and a sustained visual image will fill in the details of the percept**

- **We infer the same mechanism applies to recall of *all* semantic knowledge**
  - **Semantic knowledge is very quickly reflected in cortical electrical activity**
  - **Then the knowledge comes to consciousness**



Speed of Sight – Interpretation of EEG Data



Typical electrical activity at N100

Observation

- **After the initial evoked potential (EP) at 90 msec, there is a large drop in electrical activity – the N100**
- **Electrical activity starts to pick up at 125 msec**
- **First animal/no-animal distinction begins to occur at 150 msec – in the P200**

Our interpretation

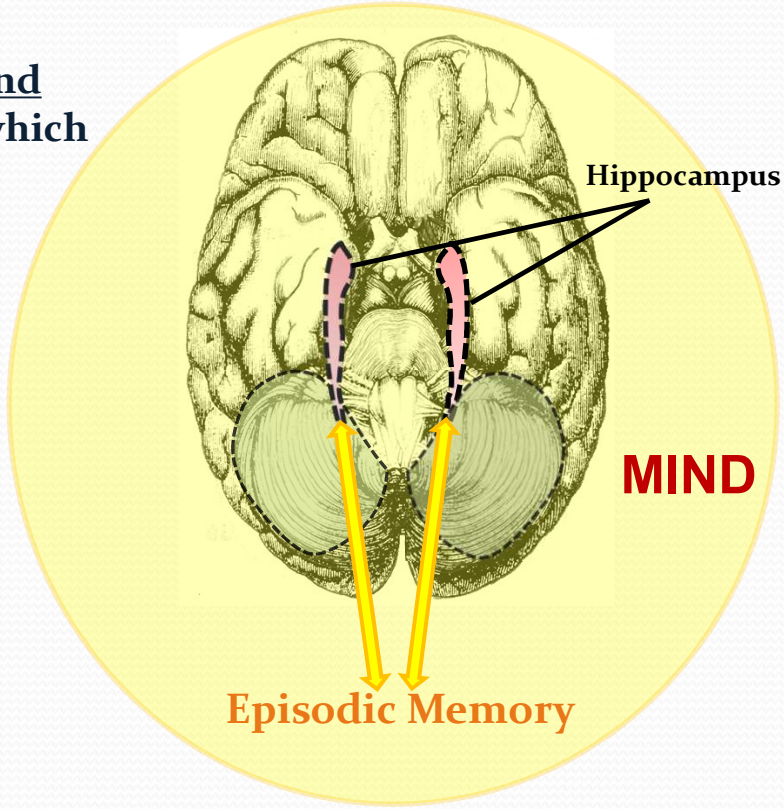
- **During N100, the *mind* represses electrical activity and impresses the semantic knowledge on the medial prefrontal cortex**
- **During P200, electrical activity in the PFC begins to bring this knowledge to consciousness**

- Thorpe, S., Fize, D., & Marlot, C. (1996). Speed of processing in the human visual system. *nature*, *381*(6582), 520-522.
- Kaunitz, L. N., Kamienkowski, J. E., Olivetti, E., Avesani, P., Murphy, B., & Melcher, D. P. (2011). Intercepting the first pass: rapid categorization is suppressed for unseen stimuli. *Frontiers in psychology*, *2*, 198.

How Does Episodic Memory Work?

Ordinary episodic memories – formed as events are experienced

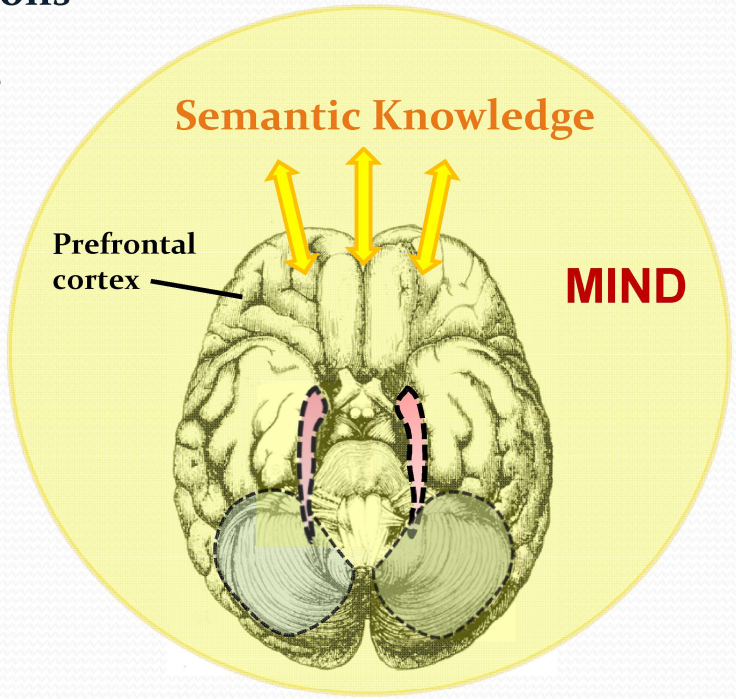
- Brain electrical activity from sensory, emotional and executive regions activate structures in the hippocampus
- Memories are formed from hippocampal activity and transferred to the mind
- Episodic memories are recalled from the mind and reactivate the hippocampal structures which repopulate the corresponding brain regions
- The memories then come to consciousness



How Does Semantic Knowledge Work?

Ordinary semantic knowledge – formed through consolidation of episodic memories through dreaming and recollection

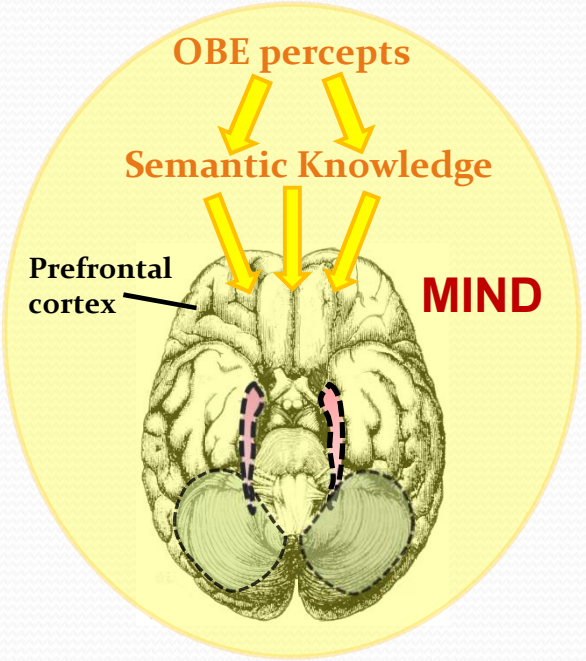
- **Salient aspects of events are formed in the mind as facts and details of one's experience—semantic knowledge**
- **Semantic knowledge resides in the mind and is recalled directly in the brain, probably in the prefrontal and temporal regions**
- **Recall of semantic knowledge of experiences can be mixed with recall of related episodic memories**



How Does NDE Memory Work?

<u>NDE memories</u> – formed *directly* as semantic knowledge, outside the physical body

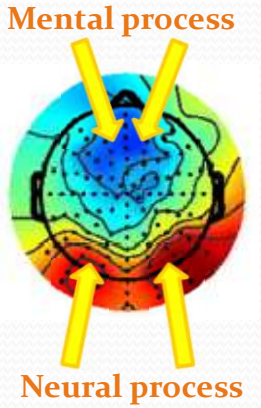
- **Memory of NDE events is formed through <u>direct interaction of the mind</u> with physical sensations and transphysical percepts**
- **The events are felt as hyperreal and the memories are vivid and indelible**
- **The memories are *not* "stored" as episodic memories and are *not* recalled through the hippocampus**
- **Rather they are formed as semantic knowledge and <u>recalled directly in the brain</u> (in prefrontal and temporal regions)**
- **Recall frequently leads to an altered state of consciousness**



The Mind's Activity in Perception

In rapid visual categorization, there appear to be two processes:

- **First: a bottom-up *neural* process forming the percept in the visual cortex**
- **Second, a top-down *mental* process – the brain activity is reduced and the mind impresses in the prefrontal cortex the structure of the parts or segments of the image**
- **The concepts and percepts are *woven together* in other parts of the brain and come to awareness as recognition and knowledge after about 300 msec.**



This idea is not new—that the mind provides the structured component to perception

The Mind's Activity in Perception …

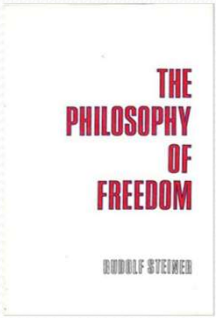
Philosopher and spiritual scientist Rudolf Steiner

- **Major philosophical work, *The Philosophy of Freedom***
- **Based on his introspection and insights into the nature of thinking and perception.**

Due to our unusual mental organization, the perceiver receives two aspects of reality:

- **One aspect from perceiving through the physical senses**
- **And one from *thinking* through *intuition***

Rudolf Steiner (1861–1925)



- Steiner, R. (1894/1964). *The Philosophy of Freedom: The basis for a modern world conception.* London, UK: Rudolf Steiner Press.

The Mind's Activity in Perception …

Philosopher and spiritual scientist Rudolf Steiner

- **Major philosophical work, *The Philosophy of Freedom***
- **Based on his introspection and insights into the nature of thinking and perception.**

Rudolf Steiner (1861–1925)

Due to our unusual mental organization, the perceiver receives two aspects of reality:

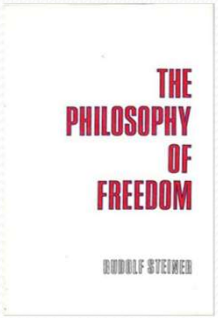
- **One from perceiving through the physical senses**
- **And one from *thinking* through *intuition***

"It is due to our mental organization that the outer world is given to us, at first without its corresponding concepts."

"Intuition adds that part of the reality—the concept—which is lacking in the percept."

"From every real thing the relevant elements come to us from two sides, from perceiving and from thinking."

"The act of knowing or cognition is the synthesis of percept and concept."



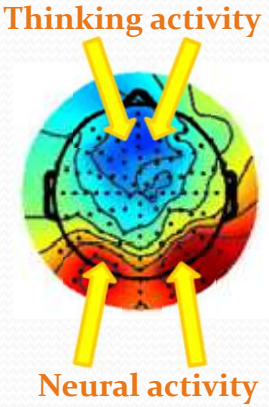
- Steiner, R. (1894/1964). *The Philosophy of Freedom: The basis for a modern world conception.* London, UK: Rudolf Steiner Press.

The Mind's Activity in Perception …

Steiner recognized that the mind needs to repress the brain activity so that the conceptual content can be given:

> **"The essence which is active in thinking has a two-fold function: first, thinking activity represses the activity of the human organization; secondly, it replaces that activity with its own activity. The repression of the physical organization prepares the way for thinking to manifest." (ch. 9)**

- **We observe this process in the prefrontal cortex: the reduced electrical activity immediately after the evoked potential.**
- **Followed immediately by electrical activity that distinguishes the content of the image – for example, animal or no-animal.**
- **The complex conceptual content distinguishing animal versus no-animal has appeared through thinking activity.**



- Steiner, R. (1894/1964). *The Philosophy of Freedom: The basis for a modern world conception.* London, UK: Rudolf Steiner Press.

The Mind's Activity in Perception …

One's thinking activity can be seen when the concept of the image is not obvious to us, for example in this hidden image.

- **If you haven't seen this image before, it probably appears like a random collection of black and white shapes.**
- **The image has not been "parsed" into meaningful segments.**
- **Actually there is an image of an animal in the picture**
- **Until one's thinking can bring the unifying concept, the image remains unsegmented, unintelligible.**
- **Once the concept dawns on one, the concept instantly organizes the image.**

> **Steiner: "[Without thinking] the world is a multiplicity of objects of equal value… Objects remain unintelligible to us until we have within ourselves the corresponding intuition which adds that part of the reality which is lacking in the percept… [Without] the intuitions corresponding to the things, the full reality remains inaccessible." (ch. 5)**

- Bortoft, H. (1986). *Goethe's scientific consciousness.* Kent, England: Institute for Cultural Research.

Explanatory Power

The mind-entity model with the model of memory explains …

- **All aspects of NDEs – phenomenology, especially veridical perceptions and NDE memories**
- **General enigmas of consciousness (hard problem, binding problem, ordinary memory)**
- **Numerous neurological anomalies:**
  - **Rapid visual categorization (speed of sight)**
  - **Readiness potential**
  - **Presentiment**
  - **Split brain phenomena**
  - **Change blindness, inattention blindness**
  - **Blindsight**
  - **Libet's antedating paradox**
  - **Libet's free will paradox, and so on**

- Mays, R. G., & Mays, S. B. (2015). Explaining Near-Death Experiences: Physical or Non-physical Causation? *Journal of Near-Death Studies*, 33(3), 125-149.